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Thinking Outside the Box: Using a Black Box Activity to Kick Off the School Year

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USING A BLACK BOX ACTIVITY TO KICK OFF THE SCHOOL YEAR

Box image by ilker; Graphic Work by Joe Taylor

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ABSTRACT: This article discusses our approach to the first days of school. Students' first experiences in our classroom set the tone for the rest of the year. We start out the year with a black-box activity to engage students and begin helping our students understand the nature of science. *This activity promotes National Science Education Standards G and Iowa Teaching Standards 1, 3, 4, 5, 6, and 8.*

Kellough & Kellough suggest teachers who create a pleasant, positive, challenging and supportive learning environment find their students to behave and learn better when compared to a classroom environment that is harsh, negative, repressive and unchallenging (2011). Importantly, the first few days of school set the tone for the rest of the school year. Therefore, the teacher must create a positive learning environment that encourages and supports student learning from the very beginning of the school year.

The activities described in this article are designed to promote student thinking, reflection, and understanding of the nature of science. By using activities that promote critical thinking and problem solving from the very beginning of the school year, we convey our high expectations for students and that science involves much more than rote memorization. Starting the school year with an activity about the nature of science challenges students to immediately start thinking and acting like scientists which can help lead students to a deeper understanding of the nature of science.

The activities we describe typically last two 50-minute segments. Although we use the black-box activity at the beginning of the year, it could be used anytime throughout the year. However, the advantage of using the box activity at the beginning of the year is that we can then refer back to it as we address the nature of science throughout the school year (Kruse, 2008).

Day 1: Creating a Positive Classroom Environment

The classroom environment not only encompass what happens during class, but also what happens before the start of class. Therefore, before students enter the room, we stand at the door to greet students. To make a more personal impression, we shake students' hands as they enter and say, “Welcome to science! You can find your seat by finding the papers with your name on them and your first assignment is on the board”. On the board is written, “Read over the course syllabus and write down three questions you have.”

Kellough & Kellough (2011) suggest that teachers place a syllabus or the first assignment labeled with individual student's names on the desks for students to peruse as they wait for class to begin. This allows students to find their own seat and for the teacher to have a seating chart pre-made. By already having a seating chart in place, we can quickly take attendance and begin learning students' names.

After attendance is taken, we tell students that their assignment (three questions about the syllabus) is due tomorrow when they walk in the door. Rather than spend the first class going over expectations (as they are doing in every other class), we begin with an activity. Our discussion of expectations will happen on the second day after they have read the syllabus and written down their questions. We find this is a more effective way for students to understand the expectations. Furthermore, once students engage in this first activity, they are more likely to ask questions about the syllabus on the second day.

Starting the First Activity

Once attendance is taken, confused students are redirected to the right classroom, and any reports to the office are sent, we begin the activity. This first black-box activity introduces students to the nature of science as well as sets up an atmosphere for investigation that will continue throughout the school year. For this activity we use “mystery boxes” made out of shoe boxes. Inside the shoe box are various items including, but not limited to: a marble, wooden blocks, cotton balls, and metal pieces. Some of these items are glued into the box while others are left loose. The box is sealed with duct tape. Use your imagination when constructing your boxes, but consider how students will collect data. For example, if the cotton balls are not glued down anywhere, the students are not likely to notice that the marble sometimes makes no sound when running into a wall. For their investigation, students are provided with white boards, magnets, and stethoscopes.

To start the lesson, we instruct one student from each pair to pick up a mystery box from the back of the room. Each box has a number on it that students are to write down in their notebooks. We tell students they will not be allowed to open the box, but that they must learn as much about the box as they can through indirect observation. At this point, we often ask

Stethoscope Safety

Introducing the stethoscopes to students provides our first lesson on safety. We ask students

- *“In what way could stethoscopes be dangerous?”*

Students typically recognize that their hearing could be damaged, so we ask

- *“How will you ensure that you are using the stethoscopes safely?”*

We also model for students how we can use the stethoscopes cautiously by not tipping the objects in the box too quickly.

- “What are some aspects of nature scientists can only observe indirectly?”

This question helps introduce students to the notion that science is limited and asks them to consider how the mystery box activity is like real science. After this brief discussion, students are given the rest of the period to examine their box.

Some tests students typically perform include:

- Rolling the marble around to determine where there are ramps and walls
- Using a magnet to determine if there are metal pieces inside
- Using a stethoscope to listen for any sounds from inside the box.

While students are working on their boxes, we walk around to answer any questions, keep students on track and interested, and scaffold student thinking. If students get stuck or say they are done, we pose questions to pique student interest or help students brainstorm other tests to perform. Also, we write questions in advance which are not simple recall questions, but questions that require the students to interpret, explain, or synthesize. According to Penick, Crow, and Bonstetter (1996), teachers must be available to answer student questions and scaffold their learning by asking leading questions. After asking questions, Kellough & Kellough (2011) suggest that the teacher wait three to eight seconds to give the students time to develop answers and relate the question to previous learning.

Questions we typically ask include:

- “What are you hoping to learn from your test?”
- “Why did you choose that test?”
- “What evidence do you have for thinking _____ is inside the box?”
- “How could you show evidence of metal in the box?”

- "How do you know the box you have is the same as other groups' boxes?"

As the class progresses, we think about our body language and facial expressions to create a welcoming and engaging environment. The old adage to "never smile before Christmas" no longer makes sense in our schools. Instead, we welcome students responses by leaning forward, smiling and using good eye contact. Also, we do not reject, accept or confirm students comments, because this could cause students to only speak when they know they are right (Penick, Crow, & Bonnstetter, 1996). Through open body language and positive, friendly facial expressions, the students will feel more comfortable in class which will promote positive relationships in the classroom.

As the period winds down, we pose the question for the students to ponder

- "How do you think the activity we are doing relates to science?"

If there is extra time at the end of the period, we have students write down their ideas on a sheet of paper to turn in on their way out the door.

Purposeful Management

In order to manage the classroom, we make clear what is expected of students. Throughout the lesson, if some students become off-task, we ask for the attention of the entire class and lead a discussion such as

- "While I understand this task may be difficult, we will be tackling challenging tasks throughout the year. Why is perseverance an important characteristic for you to develop?"

Asking students to reflect on our expectations helps them understand that our expectations are in their best interests. We support students in meeting our expectations by walking around the room. Proximity will keep students on task while allowing the teacher to see student progress. If groups of students are off-task, we ask questions to pique interest.

During this time, we are observing students' behaviors to see who works well around whom and who should be moved away from each other. This information will be beneficial when creating a new seating chart and assigning groups later in the semester.

Day 2: Continuing the Black-box Activity

When students walk in the second day we are sure to greet them at the door again. We again tell them that their task is on the board (a procedure they can expect for the rest of the year). On the board, we have written

- Exchange your three syllabus questions with your partner and see if you can answer your partner's questions.

After about three minutes, we ask students to ask any questions they still have. If students have no questions, we point out key policies and procedures for the classroom. We try hard to not set too many procedural expectations at first, because students can find these restricting and even confusing (Kellough & Kellough, 2011).

To continue the work from Day 1, students pick up their mystery boxes from the previous day and whiteboards. We instruct the students to draw their interpretation of the inside of the box on their whiteboard. The whiteboards will then be put up in the front of the room. We ask the students

- "What patterns do you see among your interpretations of the boxes?"

The students easily notice that not all boxes are the same, but those that look alike might be the same inside.

At this point, we have the student pairs get together with another pair and discuss how they arrived at their conclusions. After a few minutes, we ask the class to provide ideas for how they went about investigating the boxes. We write student ideas on the board using student phrasing to show respect for students' ideas and encourage further participation. We try to draw out key aspects of the nature of science by asking questions such as

- "How did you decide what tests to perform?"
- "What did you do when you got stuck?"
- "How did your investigation require creativity?"
- "In what way did you use evidence to come up with your ideas?"

Because students often have misconceptions about the nature of science, teachers must explicitly address the nature of science through discussions and questioning. Below are two common misconceptions about the nature of science (McComas, 1996) and questions we ask to scaffold student learning during this activity and throughout the year.

1. Myth: All research scientists follow a common series of steps when solving problems. Therefore, science involves very little creativity.
   - "How does what you did differ from the steps of the scientific method?"
   - "How does what you did to figure out the inner contents of the box compare to what scientists do to solve problems?"

2. Myth: Science provides absolute proof.
   - "How can you predict the inner contents of the box if you have never seen it?"
   - "What would happen to your prediction if new evidence appeared (i.e., you shook the box and heard a new noise)?"
   - In what way are science ideas changeable?"

When we ask, "How does what you did differ from the steps of the scientific method?" we put two columns on the board (Figure 1). List in the left column "the scientific method." Set up the second column with the label "What You Did." Use this space for students to share the ways they reached their conclusions. When comparing these columns, we encourage students to notice there is no one way to do science.

FIGURE 1
Comparison chart written onto the board.

The "Scientific Method"	What You Did
1. Make Observations 2. Propose a Hypothesis 3. Design an Experiment 4. Test the Hypothesis 5. Accept/Reject the Hypothesis 6. Revise the Hypothesis or 7. Draw Conclusions	

Not Wasting Any Time – Promoting Student Goals

Many educators have lofty goals for students. Unfortunately, these goals often get put on hold during first day activities. That is, time is spent helping students become compliant rather than engaging students in rich experiences. Importantly, the box activity above promotes many of the lofty goals we have for students. With the black-box activity, students are able to engage in higher-order thinking on the very first day of our classes. Below are several of our goals for students and a description about how this activity helps students work toward these goals.

1. Students will have a deep understanding of science content.
Through the introduction of the nature of science in the box activity, students are able to understand more thoroughly how science works. During this time, questions can be answered and misconceptions about science can be addressed or new information can be learned.

2. Students will communicate clearly and effectively in a professional manner.
Throughout the box activity, the students must present their data and explain their findings and ideas. These ideas are then discussed in small groups which creates an opportunity for students to think through their answers and communicate them clearly. At the culmination of the activity, students must discuss how they arrived at their ideas. Discussion promotes a deeper understanding of how science works while fostering communication skills in a friendly environment.

3. Students will work together to solve problems.
During the box activity, students work together to solve the mystery of the internal structure of the box. Furthermore, students are encouraged to share their thinking with other groups and the whole class.

4. Students will develop and use organizational skills.
Organizational skills are a necessity when performing scientific investigations. During the box activity, students create an investigation plan and organize their observations.

5. Students will use higher-order thinking skills.
Higher order thinking skills are necessary for students when performing inquiry based learning. During these lessons, students need to think through their processes in order to understand the structure of the boxes. Also, by asking students thought-provoking questions instead of simple short answer questions, teachers can promote the higher-order thinking skills.

6. Students creatively approach problems.
Student inquiry activities allow students to decide what tests and activities to perform in a lesson. In the box activity, the students choose investigative procedures that push them past their prior boundaries. These activities also promote approaching problems from different angles and foster student confidence.

In Conclusion

Importantly, our promotion of these and other goals does not stop with this one activity. These goals guide our decision making throughout the school year no matter the content we are trying to teach. By consistently reflecting on these goals, we hope to ensure our lessons are always helping students develop in meaningful ways.

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